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Larsen

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(54) **POLARITY PROTECTION FOR MULTIPLE BATTERIES**

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See application file for complete search history.

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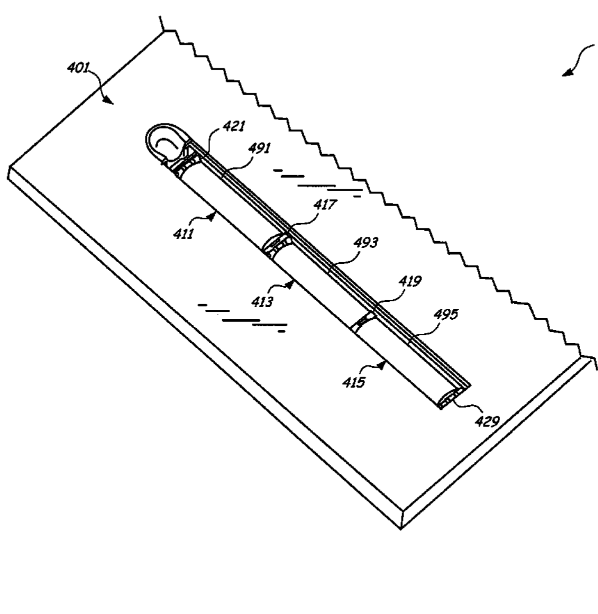
(57) **ABSTRACT**

Battery carriages are provided herein that interface with batteries in the correct polarization, regardless of the orientation in which the batteries are inserted in the battery carriages. Such battery carriages may be advantageously used with any device that uses batteries. Such a device may include two or more battery carriages, wherein each of the battery carriages includes first and second dual-contact assemblies disposed on a substrate. Each of the two dual-contact assemblies may have a positive contact and a negative contact. The positive contacts may each be configured to contact a positive terminal of a battery and to be connected to a positive circuit connection, and the negative contacts may each be configured to contact a negative terminal of a battery and to be connected to a negative circuit connection.

4 Claims, 9 Drawing Sheets



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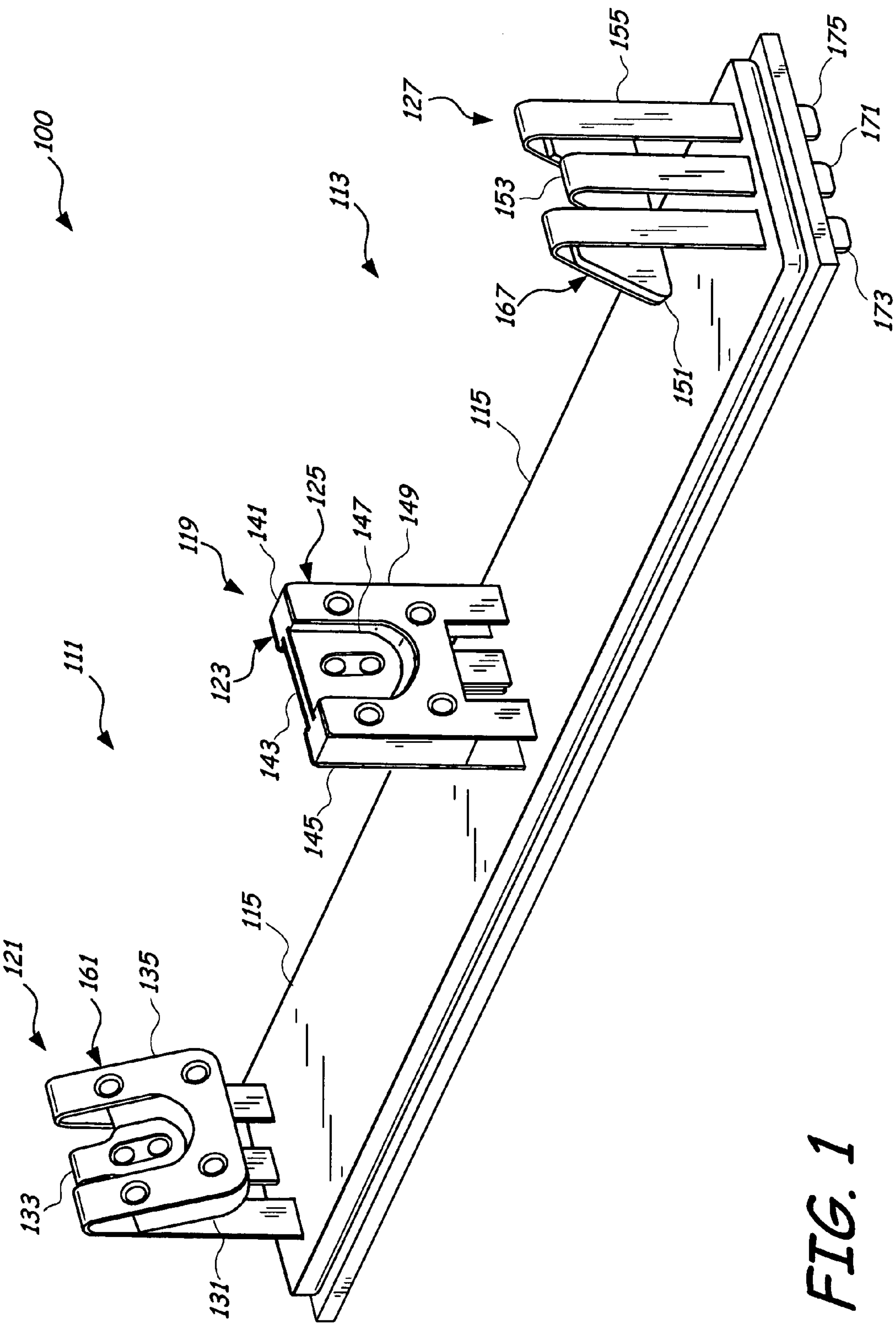
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FIG. 1

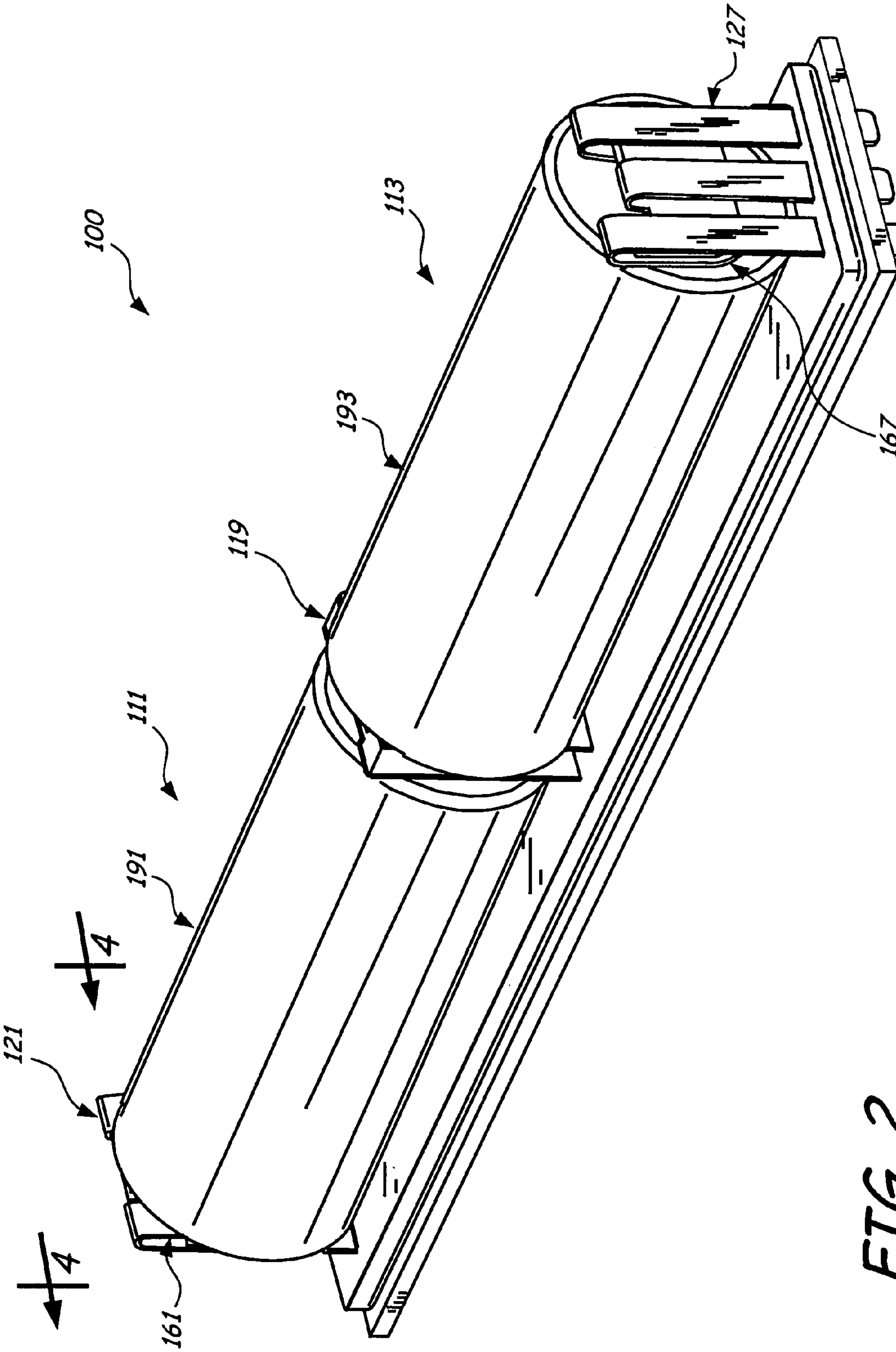

FIG. 2

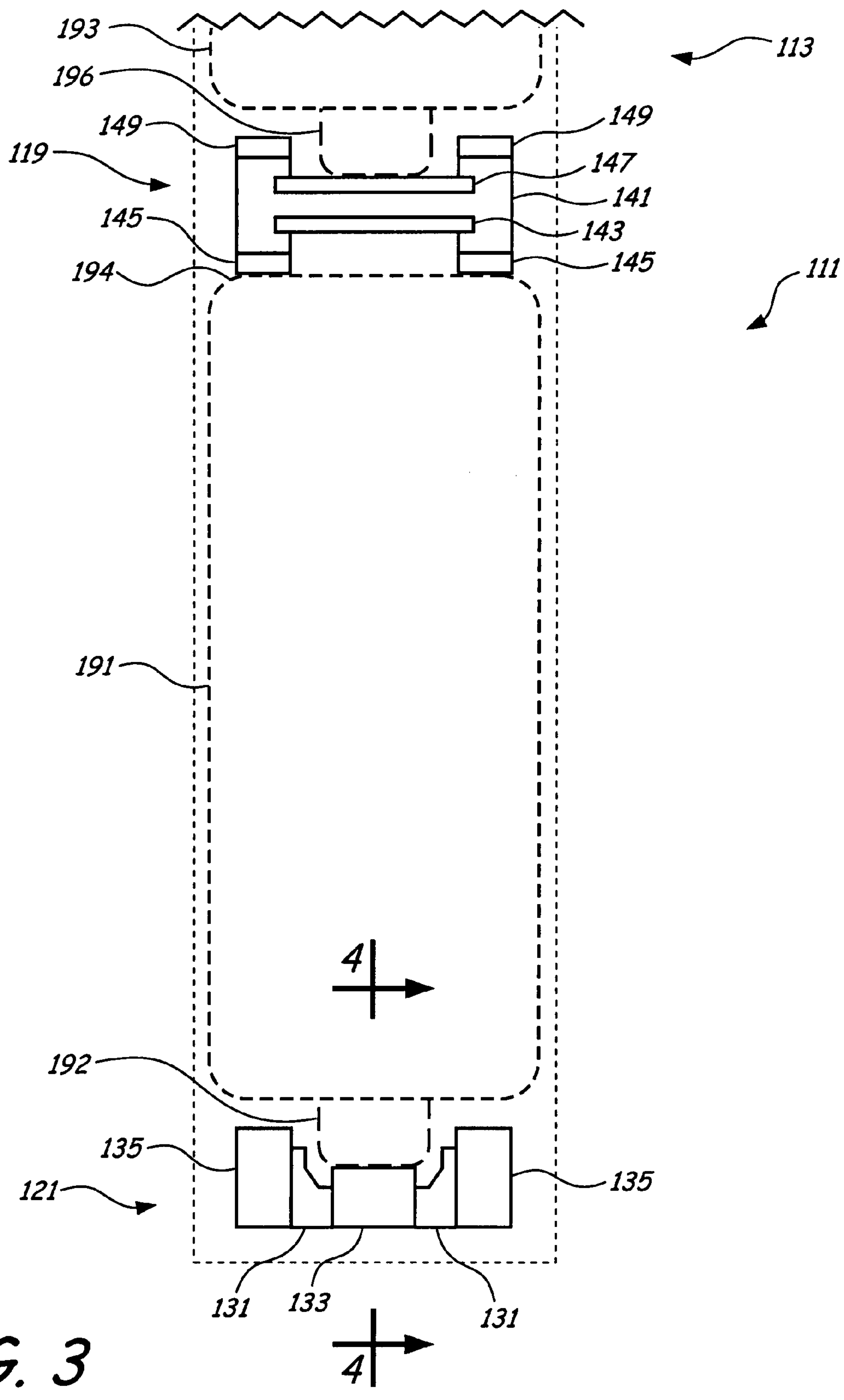
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FIG. 3

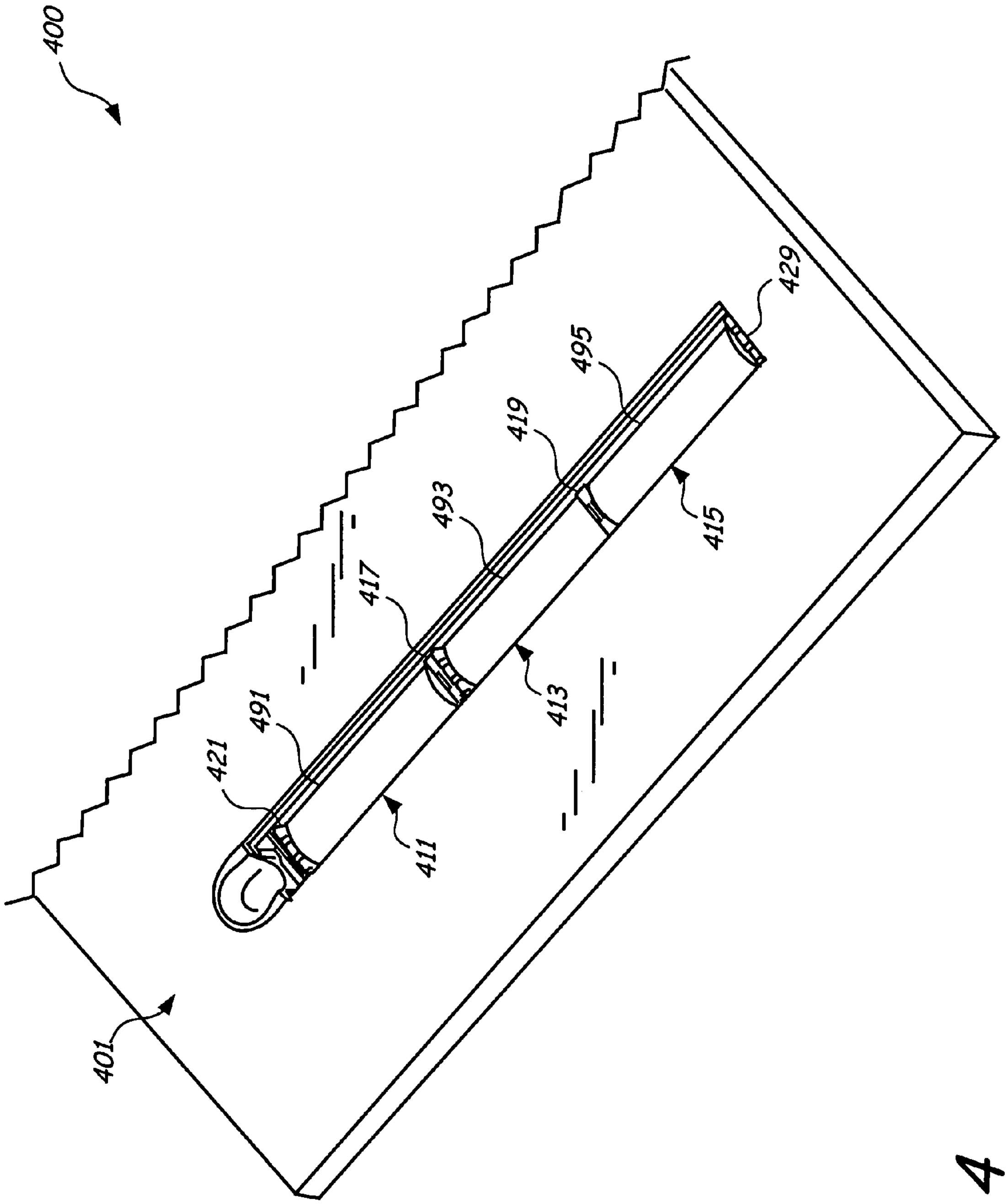
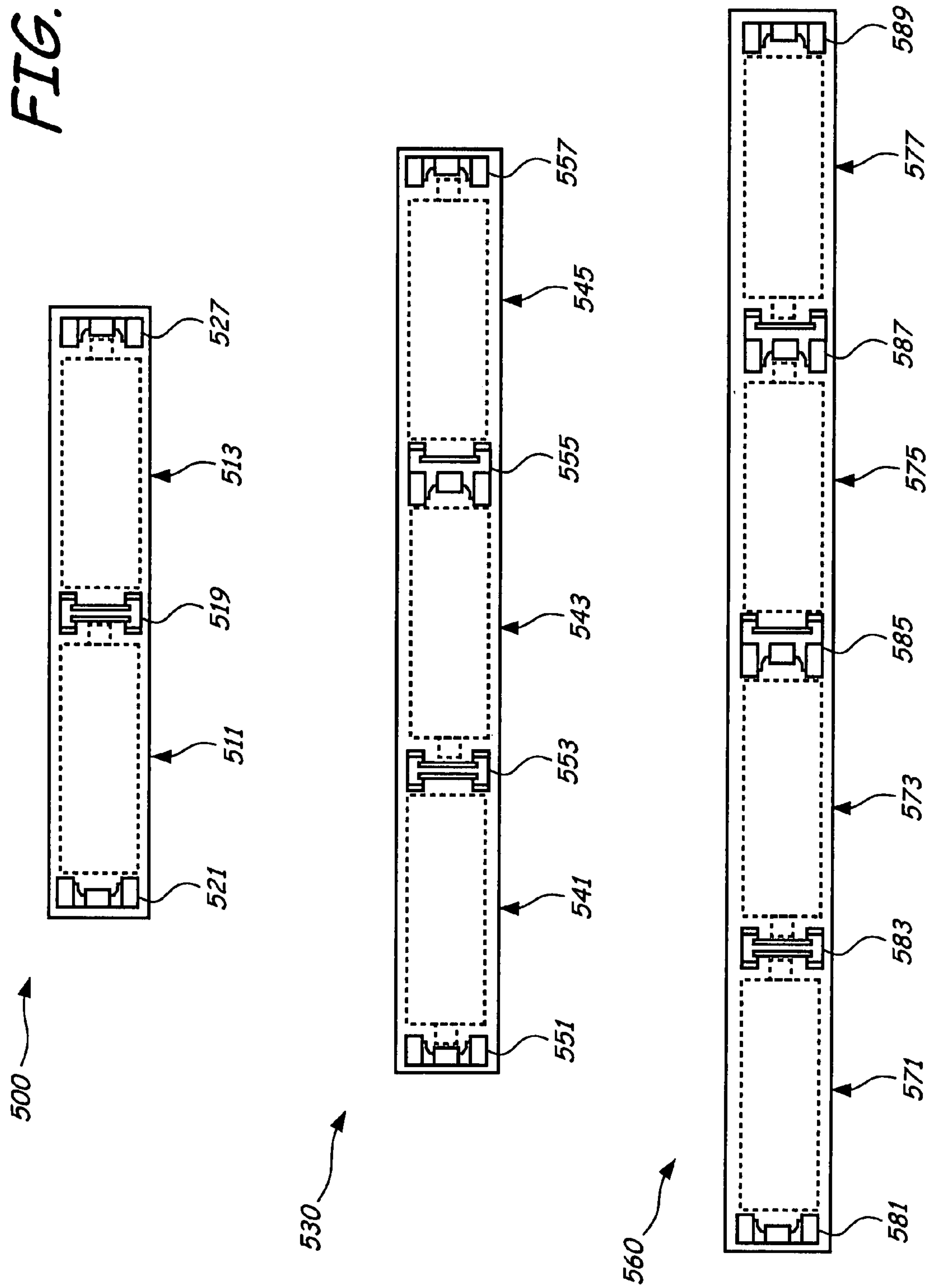


FIG. 4

FIG. 5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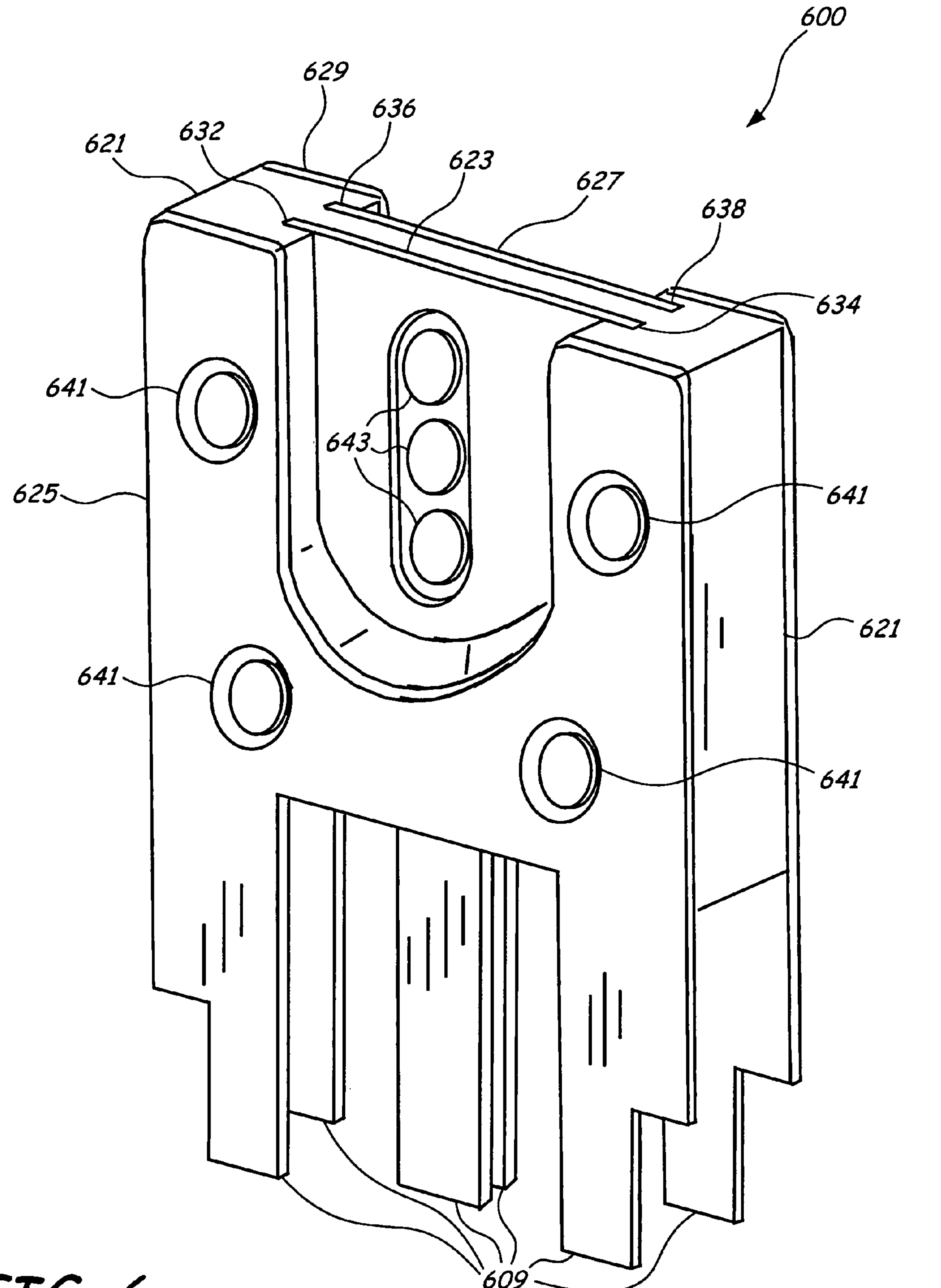

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FIG. 6

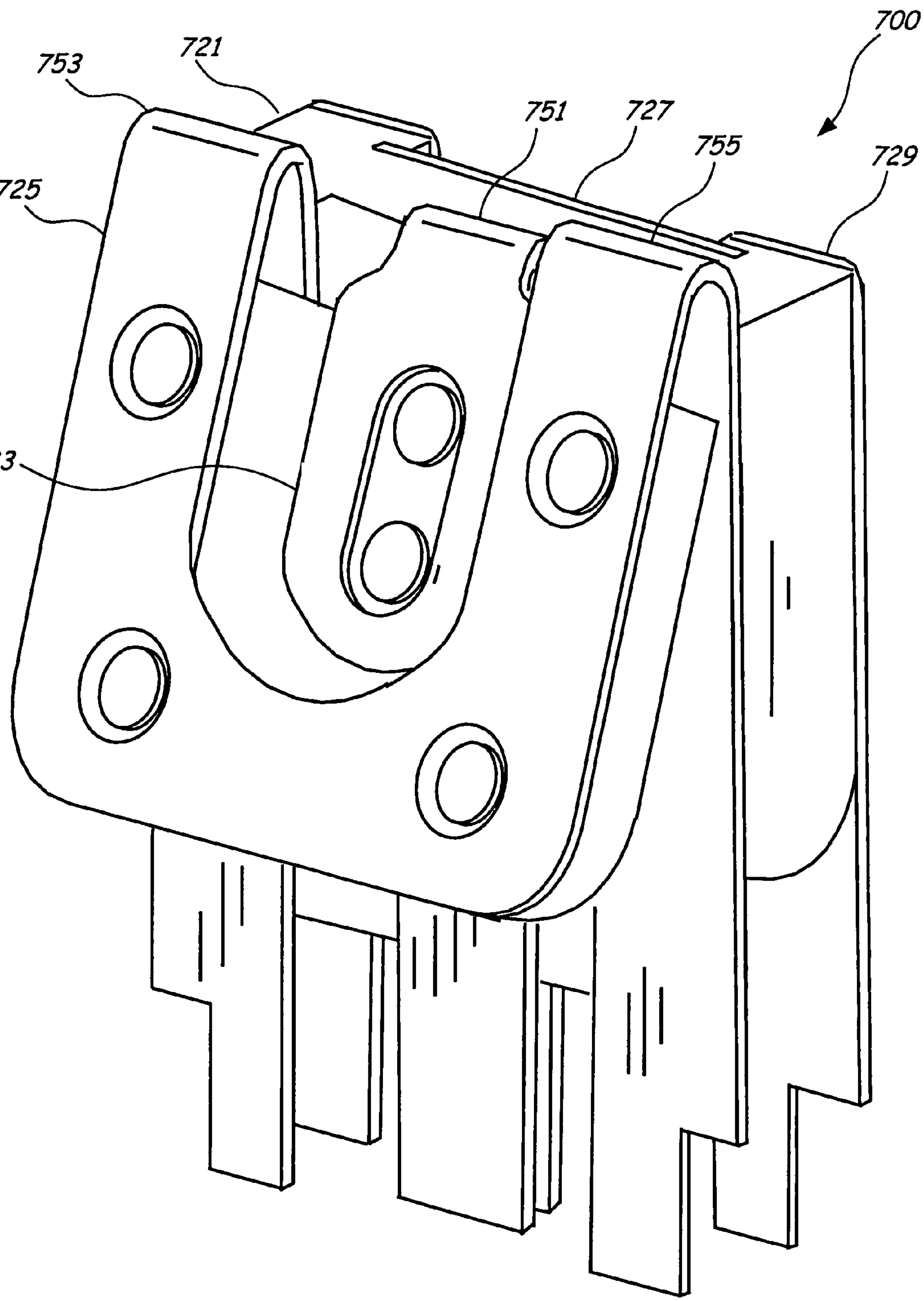

FIG. 7

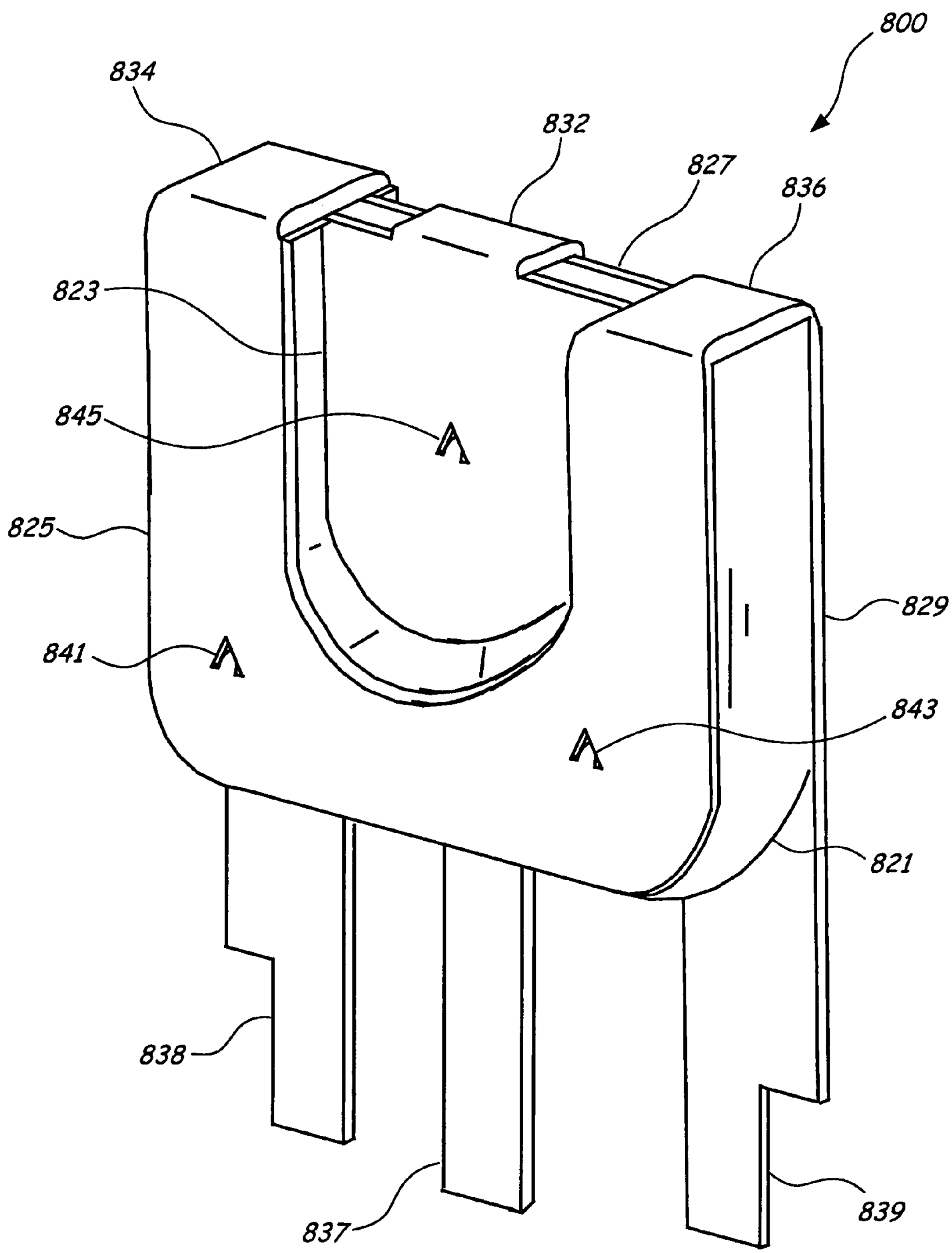

FIG. 8

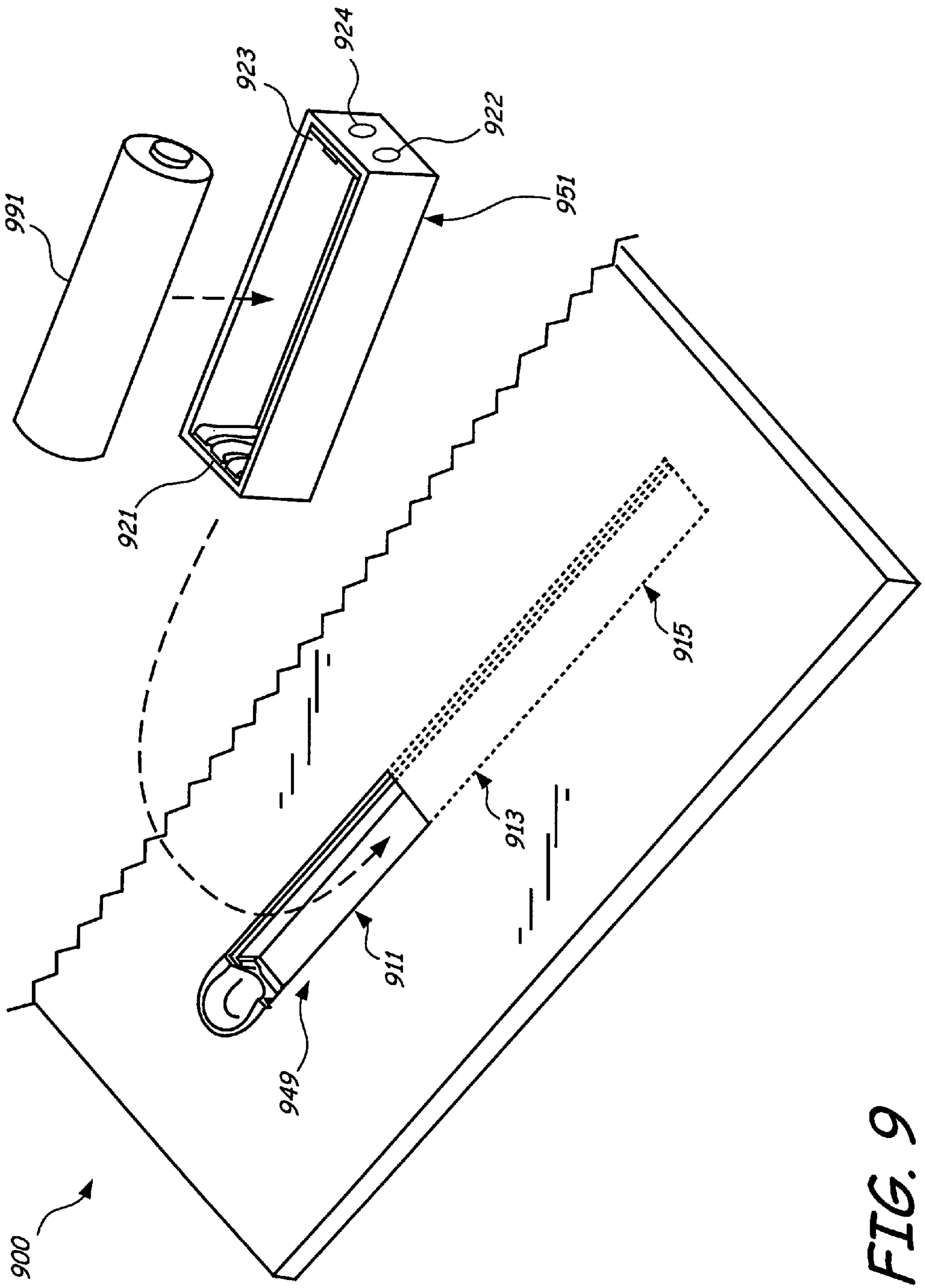

FIG. 9

POLARITY PROTECTION FOR MULTIPLE BATTERIES

BACKGROUND

Batteries must typically each be installed in a proper orientation in the electrical devices or products that draw power from such batteries. Proper installation is commonly achieved through the use of written instructions and/or graphical directions on or in the product near or in the battery receiving area, such instructions or directions identifying the proper battery orientation for correct electrical polarity. Users often follow such instructions correctly, but at times the graphics may be difficult to see as they may have been molded directly into or as part of the product housings or the directions may have been printed on what may appear to be increasingly smaller labels. Additionally, it is inevitable that batteries are inserted incorrectly at times due simply to user error. As a result, battery problems and product damage may occur. When batteries are oriented with incorrect polarity within an electronic product, the best case may be that the product cannot properly draw power and simply does not work. In worse cases, batteries can overheat and/or leak corrosive acid, which can thereby cause permanent damage to the electronics, destroy the product, cause a fire or explosion, and/or pose a threat of injury to the user. The risks involved in batteries installed in improper orientations therefore presents a persistent and substantial problem.

The discussion above is merely provided for general background information and is not intended to be used as an aid in determining the scope of the claimed subject matter.

SUMMARY

Battery carriages are provided herein that interface with batteries in the correct polarization, regardless of the orientation in which the batteries are inserted in the battery carriages. Such battery carriages may be advantageously used with any device that uses batteries. Such a device may include two or more battery carriages, wherein each of the battery carriages includes first and second dual-contact assemblies disposed on a substrate. Each of the two dual-contact assemblies may have a positive contact and a negative contact. The positive contacts may each be configured to contact a positive terminal of a battery and to be connected to a positive circuit connection, and the negative contacts may each be configured to contact a negative terminal of a battery and to be connected to a negative circuit connection.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter. The claimed subject matter is not limited to implementations that solve any or all disadvantages noted in the background.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a perspective view of a multiple battery carriage device, according to an illustrative embodiment.

FIG. **2** depicts a perspective view of a multiple battery carriage device with batteries inserted therein, according to an illustrative embodiment.

FIG. **3** depicts a top plan view of a detailed portion of a multiple battery carriage device, according to an illustrative embodiment.

FIG. **4** depicts a perspective view of a multiple battery carriage device, according to another illustrative embodiment.

FIG. **5** depicts top plan schematics of several multiple battery carriage devices, according to a number of illustrative embodiments.

FIG. **6** depicts a perspective view of a double-sided dual-contact assembly, according to an illustrative embodiment.

FIG. **7** depicts a perspective view of a double-sided dual-contact assembly, according to another illustrative embodiment.

FIG. **8** depicts a perspective view of a double-sided dual-contact assembly, according to another illustrative embodiment.

FIG. **9** depicts a perspective view of a multiple battery carriage device, according to another illustrative embodiment.

DETAILED DESCRIPTION

FIG. **1** depicts a multiple battery carriage **100**, according to an illustrative embodiment. Multiple battery carriage **100** is one illustrative embodiment of a device that allows batteries to be placed in any set of orientations in connection with a device and used effectively, as opposed to traditional devices that require each of the batteries to be placed in a certain orientation, and malfunction if this condition is not met. Multiple battery carriage **100** may be included in embodiments such as computing systems, electronic devices, and any apparatus that uses batteries, in various embodiments. The following discussion provides further details of certain illustrative examples of those various embodiments. While certain illustrative multiple battery carriages are included in this and the subsequent figures, they are intended not to indicate any limitations, but rather to indicate illustrative aspects of the variety and broader meaning provided in the discussion and claims herein.

Multiple battery carriage **100** includes first battery carriage **111** and second battery carriage **113**. First battery carriage **111** includes substrate **115** and dual-contact assemblies **121** and **123**, while second battery carriage **113** includes substrate **115** and dual-contact assemblies **125** and **127**. Dual-contact assembly **121** includes insulator **131**, positive contact **133**, and negative contact **135**; dual-contact assembly **123** includes insulator **141**, positive contact **143**, and negative contact **145**. Dual-contact assembly **125** includes insulator **141**, positive contact **147**, and negative contact **149**; and dual-contact assembly **127** includes insulator **151**, positive contact **153**, and negative contact **155**. Dual-contact assemblies **123** and **125** are both comprised together in double-sided dual-contact assembly **119**, and share one of their components in common, namely, insulator **141**. Double-sided dual-contact assembly **119** is disposed intermediate to the peripheral dual-contact assemblies **121** and **127**.

Dual-contact assembly **121** includes spring-loaded dual contact features **133** and **161**, and dual-contact assembly **127** includes spring-loaded dual contact features **153** and **167**. These spring-loaded dual contact features help ensure that a battery placed in the respective battery carriage will be resiliently and fittingly received between the dual-contact features at either end of the respective battery carriage and maintain continuous contact with the dual-contact features on both sides, in this illustrative embodiment. In other embodiments, the double-sided dual-contact assembly may have spring-loaded dual-contact assemblies on either side thereof, or more than two battery carriages with other combinations and configurations of spring-loaded dual-contact assemblies. Still other embodiments may be configured without any spring-loaded dual-contact assemblies, but may be configured to maintain a secure connection with batteries placed in the battery carriages without spring-loaded dual-contact assemblies.

Positive contacts **133**, **143**, **147**, and **153** are each configured to contact a positive terminal of a battery and to be connected to a positive circuit connection, and negative contacts **135**, **145**, **149**, and **155** are each configured to contact a negative terminal of a battery and to be connected to a negative circuit connection, as is explained in further detail below. For example, as seen for dual-contact assembly **127**, positive contact **153** has a tab that passes through substrate **115** so that its end forms contact **171**, while two tabs of negative contact **155** pass through substrate **115** as contacts **173** and **175**. The other dual-contact assemblies **121**, **123**, and **125** also have contacts that pass through substrate **115** for each of their positive and negative contacts, although these are obscured from sight in the view of FIG. **1**. Substrate **115** may take the form of a printed circuit board (PCB), for example, and may include insertion apertures into which portions of the contacts of the dual-contact assemblies may conductively contact circuit connections of the proper polarities. The circuit connections may be with external connections via the protruding portions of the tabs, or via connections within the substrate, for example.

FIG. **2** depicts multiple battery carriage **100** with batteries **191**, **193** placed in battery carriages **111**, **113** respectively. Batteries **191**, **193** are depicted in the general form of AA or AAA size batteries, though different multiple battery carriage devices may be configured to receive any different sizes and types of batteries, such as C or D size batteries, or batteries with different configurations or morphologies for positive and negative contacts, illustratively such as a standard nine volt battery. In other embodiments, the positive and negative terminals and contacts may also be reversed, for example, while battery carriage devices under these embodiments may also be configured accordingly, with a central, rearwardly positioned contact and a radially outer, annular, forwardly positioned contact that may each be configured as either a positive or negative contact, or in any other arrangement, as needed to conform with the positioning of the terminals of any type of battery in various illustrative embodiments. As can be seen in FIG. **2**, the spring-loaded dual contact features **161** and **167** and spring-loaded positive contacts **133** and **153** are reflexively deformed by the imposition of batteries **191** and **193** respectively, such that spring-loaded dual contact features **161** and **167** are pressing against batteries **191** and **193** and help to ensure continuous connections with batteries **191** and **193**. Battery **191** is therefore pressed between dual-contact assembly **121** and double-sided dual-contact assembly **119**, and battery **193** is pressed between double-sided dual-contact assembly **119** and dual-contact assembly **127**. Illustrative advantages of the dual-contact assemblies in drawing the proper charge polarity from the batteries regardless of the batteries' orientation, are depicted more clearly in FIG. **3**. FIG. **2** includes lines **4-4** that provide a frame of reference for comparing a cross-sectional view of battery carriage **111** in FIG. **3**.

FIG. **3** depicts battery carriage **111** in a top-down plan view, which more clearly depicts the interface of the dual-contact assemblies **121** and **123** with the positive and negative contacts of the battery **191**. In the depiction of FIG. **3**, the battery **191** is oriented in battery carriage **111** with the positive terminal **192** disposed in interface with dual-contact assembly **121**, and negative terminal **194** disposed in interface with dual-contact assembly **123**, which itself forms a portion of double-sided dual-contact assembly **119**; although this orientation is arbitrary, and the reverse orientation would work equally well.

As shown in FIG. **3**, the positive contact **133** of dual-contact assembly **121** is in contact with positive terminal **192** of battery **191**, due inherently to the radially inward, axially recessed position of positive contact **133** within dual-contact assembly **121**. That is, positive contact **133** is both radially inward of negative contact **135**, and recessed away from the position of battery **191** relative to negative contact **135** along an axis defined by the centers of the dual-contact assemblies and the batteries, in this illustrative embodiment. Additionally, insulator **131** helps ensure physical separation, including radially and axially, of positive terminal **192** and negative contact **135**, in this illustrative embodiment. When battery **191** is placed in battery carriage **111** with the positive terminal aligned in interface with dual-contact assembly **121**, positive terminal **192** of battery **191** is thereby caused to contact positive contact **133** and is prevented from contacting negative terminal **135**, due to the interface of the protruding shape of positive terminal **192** with dual-contact assembly **121**.

Similarly, negative terminal **194** of battery **191** is caused to be in contact with the negative contact **145** of dual-contact assembly **123**, and is prevented from contacting positive contact **143** of dual-contact assembly **123**, due to the interface of the broader, flat surface of negative terminal **194** with the radially surrounding and axially forwardly disposed position of the generally annular negative contact **145** relative to positive contact **143**. That is, negative contact **145** is disposed radially outward of positive contact **143**, and is disposed forwardly toward the position of battery **191** relative to positive contact **143** along the axis defined by the centers of the dual-contact assemblies and the batteries, in this illustrative embodiment.

So, while battery **191** is depicted in one particular orientation in FIG. **3**, it could just as easily be placed in the reverse orientation in battery carriage **111** and result in the same types of polarity interfaces, with positive and negative terminals of the battery automatically being held in contact with the proper contacts in their interfacing dual-contact assemblies, and automatically prevented from contacting the improper contacts, due inherently to the configuration of the battery carriage. In particular, with reference to the illustrative example of FIG. **3**, if battery **191** were placed in the opposite orientation in battery carriage **111**, positive terminal **192** of battery **191** would automatically be disposed in contact with positive contact **143** of dual-contact assembly **123** and prevented from contacting negative contact **145** of dual-contact assembly **123**, while negative terminal **194** of battery **191** would automatically be disposed in contact with negative contact **135** of dual-contact assembly **121** and prevented from contacting positive contact **133** of dual-contact assembly **121**. The same is also true of battery carriage **113**, as is indicated with the fragmentary depiction of battery **193** and its positive terminal **196** abutting positive contact **147** of double-sided dual-contact assembly **119**. The same may also be applied to additional battery carriages used in other embodiments; the depictions of FIGS. **1-3** are merely illustrative of the broad array of battery carriage devices that could also provide such advantages in a variety of other configurations.

A user may therefore place a battery into each of the battery carriages regardless of orientation, and be assured that the batteries are always connected to the proper contacts, and that the device automatically draws the power it needs safely and effectively.

FIG. **3** also shows the advantage of double-sided dual-contact assembly **119**, which is able to provide the inherently proper contact polarization for two batteries, one on either side thereof, while consolidating components and simplifying the configuration relative to having separate dual-contact assemblies. Double-sided dual-contact assembly **119** may have two batteries disposed on either side thereof in any combination of orientations, such that positive battery terminals contact it on either side, two negative battery terminals contact it on either side, or a positive terminal contacts it on one side and a negative terminal contacts it on the other side, and double-sided dual-contact assembly **119** ensures that each of the terminals is automatically connected with the corresponding contacts of the double-sided dual-contact assembly **119** and thereby also to the circuit connections of the proper polarities.

Double-sided dual-contact assembly **119** thereby serves as a polarity-proof battery contact assembly, in that it is proofed against a battery being disposed with an erroneous, potentially damaging polarity relative to the circuit connections of the battery carriages. When a battery is placed between an adjacent pair of the dual-contact assemblies, such as between dual-contact assemblies **121** and **123** or between dual-contact assemblies **125** and **127**, the positive terminal of the battery is conductively connected with the positive circuit connection and the negative terminal of the battery is conductively connected with the negative circuit connection, regardless of which way the terminals of the battery are oriented relative to the adjacent pair of dual-contact assemblies.

While the embodiment of FIGS. **1** and **2** depicts a device having two battery carriages in an axially adjacent configuration, these are merely illustrative of a wide variety of additional configurations, which may also include three, four, or any number of battery carriages configured with adjacent pairs of battery carriages, where multiple dual-contact assemblies may be integrated into consolidated dual-contact assemblies at any or all of the interfaces of adjacent dual-contact assemblies comprised in the device. Additionally, while double-sided dual-contact assembly **119** is depicted in FIGS. **1-3** to share insulator **141** in common, other dual-contact assemblies may also realize advantages of consolidation by sharing other components in common or forming other components for various dual-contact assemblies from single components, such as the positive contacts and the negative contacts.

FIG. **4** depicts the underside of a computer keyboard **400** that includes a multiple battery carriage **401** similar to multiple battery carriage **100** of FIG. **1**, although with three battery carriages **411**, **413**, **415** rather than two, and with two double-sided dual-contact assemblies **417**, **419** rather than one, in addition to the dual-contact assemblies **421**, **429** at the endpoints of the series of the battery carriages. As is depicted in FIG. **4**, double-sided dual-contact assembly **419** has a static dual-contact assembly on one side, and a spring-loaded dual-contact assembly on the opposite side, while double-sided dual-contact assembly **417** has static dual-contact assemblies on both sides. Together with the spring-loaded contact dual-contact assemblies **421**, **429** at the endpoints of the series, this ensures that each of the batteries is in contact with one spring-loaded dual-contact assembly, which helps ensure that each of the batteries remains in a resiliently grasping fit, and therefore that the terminals remain reliably in contact with the contact surfaces. Computer keyboard **400** is one illustrative example of a powered device that may advantageously make use, of a multiple battery carriage. A wide variety of other devices, including any battery-powered device, may also benefit from a multiple battery carriage device as described herein, and the particular example of computer keyboard **400** does not imply any limitations on the variety of other embodiments. Batteries **491**, **493**, **495** are depicted placed in battery carriages **411**, **413**, **415**. Any number of battery carriages may be included in a grouping of multiple battery carriages in other embodiments, and each interface between two adjacent battery carriages may include combined dual-contact interfaces that provide advantages relative to having separate solitary dual-contact interfaces in each of the two battery carriages. Computer keyboard **400** is provided as an illustrative embodiment of an exemplary device that may comprise and benefit from multiple battery carriages with dual-contact assemblies, though this is only one example from a great variety of devices that may benefit from groupings of multiple battery carriages with dual-contact assemblies, which may include any electrical device.

FIG. **5** depicts simplified diagrams of several illustrative configurations of multiple battery carriage devices, with different arrangements of dual-contact assemblies, some spring-loaded and others static (i.e. springless or non-spring-loaded). Battery carriage device **500** corresponds to the configuration of FIGS. **1-3**, where dual-contact devices **521** and **527** are spring-loaded single-sided dual-contact assemblies, and the interface between battery carriage **511** and **513** comprises a springless double-sided dual-contact contact assembly **519**. Battery carriage device **530** includes a series of three battery carriages **541**, **543**, **545**, with spring-loaded single-sided dual-contact assemblies **551**, **557** at the peripheries of the series of battery carriages; static double-sided dual-contact assembly **553** between the first and second battery carriages **541**, **543**; and double-sided dual-contact assembly **555** with one spring-loaded side and one static side, between second and third battery carriages **543**, **545**. In other embodiments, double static-sided assembly **553** and single static-sided, single spring-loaded sided assembly **555** could be exchanged in position, or additional static sides could be replaced with spring-loaded sides where that helps ensure reliable battery positioning, or other variations in configuration may be included, in various different embodiments.

Battery carriage device **560** includes a series of four battery carriages **571**, **573**, **575**, **577**, with spring-loaded single-sided dual-contact assemblies **581**, **589** at the peripheries of the series of battery carriages; static double-sided dual-contact assembly **583** between the first and second battery carriages **571**, **573**; and double-sided dual-contact assemblies **585**, **587** between second and third battery carriages **573**, **575** and between the third and fourth battery carriages **575**, **577**, where dual-contact assemblies **585**, **587** each have a single spring-loaded side and a single static side. As seen, the batteries are placed in various orientations in all the different battery carriages in FIG. **5**, with each terminal of each battery connected to the contact with the proper polarity, positive or negative, on the adjacent dual-contact assembly; and the batteries would remain in proper polarity in any other set of orientations. Again, a variety of other configurations may also occur in other embodiments, in which the positioning of the assemblies may be rearranged, additional static assemblies may be replaced by spring-loaded assemblies or vice versa as consistent with desired battery positioning, and variations of other kinds may be made.

Each of battery carriage devices **500**, **530**, **560** thereby ensures a resiliently secure connection for batteries placed in each of the battery carriages of each of the devices. Battery carriage devices **500**, **530**, and **560** illustrate a few of the various configurations that may be composed using different types of dual-contact assemblies as disclosed herein. Other devices that include any of a wide variety of other configurations of dual-contact assemblies are encompassed within the present disclosure that are encompassed within the embodiments that may be extrapolated with different combinations of dual-contact assemblies such as those depicted in FIG. **5**, in any combination and with any number or arrangement of battery carriages.

FIG. **6** provides a clearer depiction of a springless double-sided dual-contact assembly **600** similar to springless double-sided dual-contact assemblies **119**, **519**, **553**, and **583** of the previous figures. Similar to those dual-contact assemblies, dual-contact assembly **600** includes insulator **621**, positive contacts **623** and **627**, and negative contacts **625** and **629**.

FIG. **6** facilitates the depiction of details of the springless double-sided dual-contact assembly, such as notched or stoppered tabs **609**, which may be implanted into slots in a substrate such as substrate **115** of FIG. **1** to a self-limiting depth controlled by the positions of the notch steps on the tabs **609**. A narrower section defined below each of the notch steps is configured to engagingly penetrate a mounting aperture in the substrate, while a wider stopper section is defined above the notch steps and is configured to limit the depth of penetration of the tab. The tabs connected with each of positive contacts **623**, **627** are configured to be connected to the positive circuit connection, and at least one of the tabs connected with each of negative contacts **625**, **629** is configured to be connected to the negative circuit connection.

These stoppered tabs therefore help provide for the dual-contact assembly **600** to be positioned at the proper height relative to the substrate. In other illustrative embodiments, any number of stoppered tabs or analogous mechanisms may be included. This may include only a single stoppered tab per dual-contact assembly in one embodiment, or more than are depicted in FIG. **6**, as consistent with reliably maintaining the positioning of the dual-contact assemblies. Ensuring the proper height of the assemblies may also be provided by other types of mechanisms, such as formed L-shaped bends in the metal contacts, extensions of the plastic insulators, additional spacer parts, or other mechanisms or combinations of the those described above.

Additional detailed features include embedded wings **632**, **634** of positive contact **623** and embedded wings **636**, **638** of positive contact **627**. These positive contacts are wider than the exposed area that is available to contact a battery terminal, with the peripheries thereof forming wings that are embedded in insulator **621**. These embedded wings help ensure that positive contacts **623**, **627** durably maintain their proper position within dual-contact assembly **600**.

Additional features that serve to ensure the structural stability of dual-contact assembly **600** are plastic stakes **641** that anchor the negative contact **625** against insulator **621**, and plastic stakes **643** that anchor the positive contact **623** against insulator **621**, along with corresponding plastic stakes, obscured from view in FIG. **6**, that anchor negative contact **629** and positive contact **627** against insulator **621**. Insulator **621** may be composed of an injection molded plastic or other electrically insulative material, and the conducting components then joined to it, for example, in this illustrative embodiment. Each of the contacts **623**, **625**, **627**, and **629** may be formed with apertures at the positions where the plastic stakes are depicted, where the injection molded plastic of the insulator **621** may project through the apertures. Each of the projections of plastic may then be heated and compressed against the contacts, so that they are radially expanded and compressed around the annulus of their respective apertures, and set into the form depicted in FIG. **6**, in which each of the plastic stakes tightly anchors its respective contact against insulator **621**. A wide variety of other features and manufacturing processes, including but not limited to ultrasonic welding, metal insert injection molding, adhesives, and so forth, may also be used to integrate the structural elements of various dual-contact assemblies, under a wide variety of embodiments of which the embodiment of FIG. **6** is merely illustrative.

Similar features are also shown in FIG. **7**, which depicts double-sided dual-contact assembly **700** that has spring-loaded contacts on one side, for positive contact **723** and negative contact **725**, and springless contacts on the other side, for positive contact **727** and negative contact **729**. In particular, positive contact **723** is connected to insulator **721** via spring-loaded joint **751**, and negative contact **725** is connected to insulator **721** via spring-loaded joints **753**, **755**. Double-sided dual-contact assembly **700** also features plastic stakes and notched tabs similar to those of double-sided dual-contact assembly **600** of FIG. **6**. Other embodiments may also occur, such as with spring-loaded dual-contact assemblies on both sides of assembly **700** rather than one spring-loaded side and one static side as depicted in FIG. **6**, for example. Any or all of the double-sided dual-contact assemblies in a battery carriage device, such as those depicted in FIG. **5**, may be provided in the form shown in FIG. **7** as another illustrative example.

FIG. **8** provides yet another illustrative example of a double-sided dual-contact assembly **800** that may be used, in any combination with other components, in a battery carriage device. Double-sided dual-contact assembly **800** provides additional advantages that are best seen in light of a background relative to the potential for series and parallel battery connections.

In different battery carriage devices, it may be desirable to have the circuit connections of the battery carriages connected in series or in parallel. In typical end-to-end multiple battery carriages, the circuit connections are arranged in series, to go along with the constraint that each of the batteries must be inserted in the proper orientation so that the proper polarity of connections will be conductively connected to the circuit connections. These arrangements also do not include parallel circuit connections.

Different embodiments disclosed herein may automatically ensure proper series or parallel connections of the batteries in each of the multiple battery carriages, regardless of the orientation of each of the batteries, because of the dual-contact assembly at the positions of each of the battery terminals. As those skilled in the art will easily appreciate, a parallel connection with the battery carriages may be automatically ensured by providing conductive connections of the positive contacts in each of the dual-contact assemblies with a common positive connection, and providing conductive connections of the negative contacts in each of the dual-contact assemblies with a common negative connection; while a series connection with the battery carriages may be automatically ensured by providing chained connections of the positive contacts in each of the dual-contact assemblies, and chained connections of the negative contacts in each of the dual-contact assemblies.

Additionally, if the battery carriage device is designed for parallel connection, then the positive contacts on either side of a double-sided dual-contact assembly may be connected in the substrate, and the negative contacts on either side of the double-sided dual-contact assembly may be connected in the substrate. However, since they would be connected anyway in the vicinity of the double-sided dual-contact assembly, the contacts from both sides of the double-sided assembly may be combined in the assembly itself, with their corresponding contacts on the opposing sides of the assembly. This is depicted in FIG. **8**, according to one illustrative embodiment.

In FIG. **8**, positive contacts **823**, **827** are connected together as sections of a single, integral component via connecting bridge **832** that spans the top of double-sided dual-contact assembly **800**, while negative contacts **825**, **829** are also connected together as sections of a single, integral component via connecting bridges **834**, **836** that span the top of double-sided dual-contact assembly **800**. In other embodiments, only a single one of connecting bridges **834**, **836** may be included, since only one is necessary to provide electrical conductivity between negative contacts **825**, **829**, as one among many potential examples of different configurations available in different embodiments. For the combined positive contact component, only one single notched tab **837** is needed to conductively interface with a positive circuit connection, and the two notched tabs **838**, **839** conductively interface with a negative circuit connection. In another illustrative embodiment, only a single notched tab may be used to conductively interface with the negative circuit connection, for example. Configurations such as these may save material and weight in the double-sided dual-contact assembly **800** as well as free up space adjacent to it on one side, and potentially reduce the required manipulation of the substrate and the circuit connections due to the simpler design and freed-up space.

Another illustrative feature is depicted in FIG. **8** as another example of how the contacts of a dual-contact assembly may be reliably secured together with the internal insulator **821**, by using retention barbs **841**, **843** on negative contact **825** and retention barb **845** on positive contact **823**, as well as a similar arrangement on the opposite face of dual-contact assembly **800**. A potentially analogous configuration may be used in any other dual-contact assemblies that may be incorporated in a battery carriage device, in addition to still other embodiments. Retention barbs **841**, **843**, **845** may be formed by cutting chevron forms in the contacts and pressing the chevron forms inward, to bite into insulator **821**, thereby providing another mechanism for the contacts **823**, **825**, **827**, **829** to remain securely fastened together with insulator **821**. The chevron forms of the retention barbs as depicted are only one illustrative configuration, and barbs and other fastening mechanisms are not limited to the depicted example in other embodiments, but may take any of a broad variety of forms that serve to fasten the components together.

FIG. **9** depicts a device **900** that has a partially enclosed slot **949** in it, much of which is covered over, and the interior of which is accessible through the relatively smaller opening in the slot. Device **900** still includes battery carriages **911**, **913**, **915**, while some of them are enclosed within the covered portion of the slot **949**, as depicted in dotted lines in FIG. **9**.

Device **900** also includes several battery carriages in the form of cartridge **951** that are configured to be capable of passage, one at a time, into slot **949** through the opening of the slot, as shown. Each cartridge **951** includes dual-contact assemblies **921**, **923** at either end thereof, so that a battery may be placed in any orientation within each cartridge **951**, while once again maintaining polarity-proof external electrical contacts to be provided to a circuit connection of the device **900**. Dual-contact assembly **921** is depicted as being spring-loaded while dual-contact assembly **923** is depicted as being static, to help ensure that a battery positioned between them is resiliently grasped and remains firmly positioned in place, while in other embodiments, reliable battery positioning may be achieved with static assemblies on both sides, spring-loaded assemblies on both sides, or combinations of these options with other mechanisms for maintaining battery positioning, in various embodiments.

The slot **949** includes positive and negative battery connections (not depicted in FIG. **9**) configured to interface with external positive and negative electric contacts **922**, **924** respectively, on the exterior of cartridge **951**, along with corresponding contacts on the reverse side of cartridge **951**. Each of several batteries such as battery **991** may be inserted first into a cartridge **951**, and then cartridge **951** inserted into slot **949** and slid back into place under the covering of the slot, until the proper number of cartridges have been inserted to fill the length of slot **949**, while that proper number may be any number depending on the configuration of a particular embodiment. The cartridges **951** may be configured to conformingly and separably engage in the slot **949**, such that when the cartridges **951** are conformingly engaged in the slot **949**, the cartridges **951** are connected to the positive and negative circuit connections of the slot **949** and thereby of the device **900**.

This forms yet another illustrative embodiment that may yield a number of additional advantages. For example, the cartridges and covered slot may provide greater assurance that the batteries will stay in place and in maintenance of a secure electrical connection even if the device **900** is jostled or dropped or otherwise subjected to forces and shocks that, in a traditional device, might otherwise break the circuit connection of the batteries or dislodge the batteries from their proper positions, particularly in a traditional device in which the batteries are all held in place with a cover panel that could be simultaneously impacted by the force of all the batteries at once if the device is subjected to a shock impact.

As another illustrative advantage of device **900**, the electrical contacts on either end of each of the cartridges may be connected together with the opposite contact of like polarity within the slot, in addition to fixed conductive connections at the endpoints of the slot. Because of this, any number of the cartridges may be filled with batteries and any number may be left empty, and the cartridges will still form a complete circuit within the slot once they are all inserted into place, that is able to deliver power to the host device from whatever cartridges happen to contain batteries. Then, for example, if a user did not have enough charged batteries to fill all the cartridges, and even if the user has only a single charged battery, the user may still put the limited number or the one single charged battery into the cartridges, insert the full and empty cartridges together in the slot, in any order and any orientations, and the circuit will be complete, and power will be provided sufficient to power the device **900**.

In yet other illustrative embodiments, batteries may be provided that are securely encased within cartridges similar to cartridge **951**, or batteries may be manufactured to have a form factor analogous to that of cartridge **951**, so that the cartridge is integrally configured as a battery and is ready-made for use in a device with a slot-defined series of battery carriages such as in device **900**. This would provide further advantages of freeing the user from having to perform the sequence of steps of first placing one or more batteries into a cartridge, and then placing the cartridges in place in the slot. This embodiment may also enable the interior space of each of the cartridges to be more efficiently used to house the internal materials of a battery, so that a greater amount of energy and a longer battery life can be packed into the same volume within the cartridge.

Although the subject matter herein has been described in language specific to certain illustrative structural features, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to any of the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims. As a particular example, while many embodiments are presented with illustrative elements that are widely familiar at the time of filing the patent application, it is envisioned that many new innovations in technology will affect elements of different embodiments, and that the elements defined by the claims may be embodied according to these and other innovative advances while still remaining consistent with and encompassed by the elements defined by the claims herein.

What is claimed is:

1. A device comprising:

a component with a slot therein, the slot comprising positive and negative contacts for positive and negative circuit connections; and

a battery cartridge removably insertable into the slot and including external positive and negative contacts on an exterior of the battery cartridge, the external positive and negative contacts being electrically coupleable to the positive and negative contacts in the slot upon insertion of the battery cartridge into the slot, wherein the battery cartridge comprises:

an internal compartment configured to removably receive at least one battery; and

first and second dual-contact assemblies positioned at ends of the internal compartment, each of the first and second dual-contact assemblies comprising:

a positive contact configured to contact a positive terminal of a battery and to be electrically coupled to the positive circuit connection, and

a negative contact configured to contact a negative terminal of a battery and to be electrically coupled to the negative circuit connection.

2. The device of claim **1**, wherein the slot is partially enclosed and is accessible through an opening that is smaller than the slot, wherein the battery cartridge is configured to be passed through the opening.

3. The device of claim **1**, the battery cartridge comprising a joint cartridge that comprises a plurality of battery carriages, each of the battery carriages comprising first and second dual-contact assemblies.

4. The device of claim **1**, and further comprising:

a second battery cartridge configured to removably receive at least one battery, the battery cartridge being removably insertable into the slot and electrically couplable to the positive and negative circuit connections of the slot, wherein the second battery cartridge comprises:

first and second dual-contact assemblies, each of which includes:

a positive contact configured to contact a positive terminal of a battery and to be electrically coupled to the positive circuit connection, and

a negative contact configured to contact a negative terminal of a battery and to be electrically coupled to the negative circuit connection.

* * * * *